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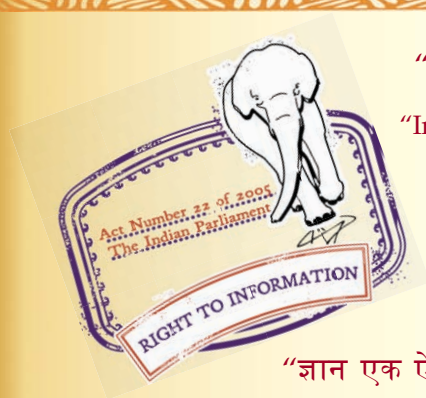
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IS 15673 (2006): Flow measurement of natural gas by rotary piston meters [PGD 26: Weights and Measures]



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भारतीय मानक
रोटरी पिस्टन मीटर द्वारा प्राकृतिक गैस
का प्रवाह मापन

Indian Standard
FLOW MEASUREMENT OF NATURAL GAS
BY ROTARY PISTON METERS

ICS 75.160.30; 75.180.30

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NEW DELHI 110002

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Weights and Measures Sectional Committee had been approved by the Production and General Engineering Division Council.

This standard is formulated for measuring the gas consumption at the user's end, when the gas is supplied through the pipelines. In order to meet the requirement by the users only the Bureau of Indian Standards, has formulated the above Indian Standard for accuracy of metering system to fulfill the consumer satisfaction. This standard used for custody transfer of natural gas.

In preparing this standard considerable assistance has been derived from the following publication:

IS 14439 (Part 3) : 1998 Legal metrology — Gas volume meters: Part 3 Rotary piston and turbine gas meters

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

**AMENDMENT NO. 1 DECEMBER 2008
TO
IS 15673 : 2006 FLOW MEASUREMENT OF NATURAL
GAS BY ROTARY PISTON METERS**

(Second cover, Foreword, third para) — Substitute the following for the existing para:

‘This standard is first published as IS 14439 (Part 3) : 1998 Legal metrology — Gas volume meters: Part 3 Rotary piston and turbine gas meters. Due to publication of this standard, IS 14439 (Part 3) : 1998 is to be withdrawn.’

(PG 26)

Reprography Unit, BIS, New Delhi, India

Indian Standard

FLOW MEASUREMENT OF NATURAL GAS
BY ROTARY PISTON METERS

1 SCOPE

This standard specifies the requirements for the construction, methods of pressure tapping, working ranges with nominal values of minimum/maximum flow rates and permissible errors for rotary piston meters.

2 REFERENCE

The standard listed below contains provision which through reference in this text, constitutes provision of this standard. At the time of publication, the edition indicated was valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below:

IS No.	Title
14439 (Part 1): 1997	Legal metrology — Gas volume meters: Part 1 General requirements

3 TERMINOLOGY

For the purpose of this standard, the following terminology shall apply.

3.1 Rotary Piston Meters, are those, in which internal walls defining the measuring chambers are set in rotation and the number of revolutions of these walls represents a measurement of the volume of the gas passed.

4 WORKING RANGE

The nominal values of the maximum flowrates and the corresponding minimum flowrates of rotary piston meters are given in Table 1.

5 MATERIAL FOR CONSTRUCTION

5.1 Material

The material for construction of the gas meters and its components shall be as specified in IS 14439 (Part 1).

5.2 Details of Construction

5.2.1 Rotary piston meters shall have a static pressure tapping at the inlet and at the outlet, close to the connection (flange) for measuring the pressure absorption, the pressure measured upstream shall constitute the metering pressure. Length between the ends of its inlet and outlet connection shall be less than or equal to 5 times nominal connection.

5.2.2 Rotary piston gas meters may include a manual device for allowing the pistons to be turned, provided that it cannot be improperly used in such a way to interfere with the correct functioning of the gas meter.

5.2.3 Notwithstanding the requirements given in 9 of IS 14439 (Part 1) the bearings of the shafts of the

Table 1 Flowrate Values
(Clause 4)

Sl No.	Gas Meter Designation G	q_{Max} m ³ /h	Working Range			
			1 : 10	1 : 20	1 : 30	1 : 50
				q_{Min} m ³ /h		
i)	10	16	1.6	—	—	—
ii)	16	25	2.5	1.3	0.8	0.5
iii)	25	40	4	2	1.3	0.8
iv)	40	65	6	3	2	1.3
v)	65	100	10	5	3	2
vi)	100	160	16	8	5	3
vii)	160	250	25	13	8	5
viii)	250	400	40	20	13	8
ix)	400	650	65	32	20	13
x)	650	1 000	100	50	32	20
xi)	1 000	1 600	160	80	50	32

rotating pistons of gas meters (roots type) of a size greater than 'G 160' may be constructed in such a way as to allow them to be replaced without damaging the protective seals.

5.3 Pressure Tappings

5.3.1 The bores for pressure tappings shall have a diameter of at least 3 mm. In the case of slit-shaped pressure tappings, slits shall have a width of at least 2 mm in the direction of the flows and a cross-section of at least 10 mm².

5.3.2 Pressure tappings shall be provided with a means of closure so as to make them gas-tight.

5.3.3 The pressure tapping for the metering pressure shall be clearly and indelibly marked 'p_m' and other pressure tappings as 'p'.

5.4 Built-in Conversion Device

5.4.1 Rotary piston gas meters may have a built-in conversion device which converts the volume at metering temperature to that at base temperature or which converts the volume at metering conditions to that at base conditions.

5.4.2 The indicating device for the volume at base conditions shall have a sufficient number of digits to ensure that the volume passed during 2 000 h at maximum flowrate, minimum temperature and, if applicable, maximum pressure does not move or switch all the digits to their initial positions.

6 TEST ELEMENTS

6.1 When the gas meter has a mechanical test element according to 6.2.2 of IS 14439 (Part 1), the scale interval and the scale numbering shall be according to Table 2.

6.2 The scale interval of the test element of the indicating device for base conditions shall be less than 0.1 percent of the converted volume counted in 3 min with the maximum flowrate at maximum temperature and, if applicable, minimum pressure.

7 MAXIMUM PERMISSIBLE ERRORS

7.1 Under the conditions laid down in 7 of IS 14439 (Part 1), the maximum permissible errors applicable to all the gas meters shall be as follows:

Flowrate 'q' m ³ /h	Maximum Permissible Errors	
	On Initial Verification, Percent	In Service, Percent
$q_{Min} \leq q \leq q_t$	±2	±1
$q_t \leq q \leq q_{Max}$	±3	±1.5

NOTE — In service, values are recommended values.

The values for the transitional flowrate 'q_t' are as follows:

Working Range	'q _t '
1 : 10	0.20 q _{Max}
1 : 20	0.20 q _{Max}
1 : 30	0.15 q _{Max}
1 : 50	0.10 q _{Max}

7.2 On initial verification at one set of metering conditions, the gas meter shall be adjusted so that the weighted mean error (WME) is as close to zero as the adjustment and the maximum permissible errors allow.

$$WME = \frac{\sum_{i=1}^n (q_i / q_{Max}) \times E_i}{\sum_{i=1}^n (q_i / q_{Max})}$$

where

q_i/q_{Max} = weighing factor, and
E_i = error at the flowrate q_i as specified in 9.2.1 (where q_i = q_{Max} a weighing factor of 0.4 instead of 1 shall be used).

The WME shall have a value between -0.4 percent and +0.4 percent.

The maximum permissible errors on initial verification apply to new meters and to meters

Table 2 Scale Intervals and Numbering
(Clause 6.1)

Sl No.	Designation G for Working Range			Maximum Scale Interval m ³	Numbering After Every m ³
	1 : 10 1 : 20	1 : 30	1 : 50		
i)	—	—	16	0.0002	0.001
ii)	10-65	16-100	25-160	0.002	0.01
iii)	100-650	160-1 000	250-1 600	0.02	0.1
iv)	1 000-10 000	1 600-10 000	2 500-16 000	0.2	1
v)	≥ 16 000	≥ 16 000	≥	2	10

submitted for verification after the protective seals have been damaged.

NOTE — After changing the adjustment, it is not necessary to repeat all tests. It is sufficient to repeat a test at one flowrate and calculate the other new E_i values from the previous ones.

7.3 When the maximum torques indicated on the gas volume meter according to 4.3.2.1 and 4.3.2.2 of IS 14439 (Part 1) are applied to the drive shafts, the indication of the gas volume meter at q_{Min} when tested with atmospheric aid (of density 1.2 kg/m^3) shall not shift more than the values given below:

Value of q_{Min}	Permissible Shift of the Indication at, q_{Min} , Percent
$0.02 q_{Max}$	1
$0.03 q_{Max}$	1
$0.05 q_{Max}$	1
$0.1 q_{Max}$	0.5

8 PATTERN APPROVAL

8.1 Request for Pattern Approval

8.1.1 Manufacturer shall submit the sample for pattern approval to the appropriate authority. Manufacturer shall place two to six samples manufactured in conformity with the pattern at the disposal of the authority responsible for examination.

8.1.2 If so requested by the authority responsible for the examination, these meters should include more than one size, if simultaneous approval of those sizes is requested.

8.1.3 Depending on the results of the tests, additional sample meters may be requested.

8.1.4 Notwithstanding the above requirements, the sample meters may be submitted at different times, but the decision regarding pattern approval will be given only when all these sample meters have been received and examined.

8.2 Tests

8.2.1 General

The pattern and its sample meters shall comply with the requirement of IS 14439 (Part 1) and 4, 5, 6 and 7 of this standard.

In addition, for flowrates, between $0.4 q_{Max}$ and q_{Max} the difference between the maximum and minimum of the error curve as a function of the flowrate ' q ' shall not exceed 1 percent for each meter.

8.2.2 Disturbance Test for Rotary Piston Meters

Rotary piston meters shall be subjected to a test for the influence of flow disturbances as specified in Annex A. During the test the shift of the error curve shall not exceed 0.33 percent.

If the design of a rotary piston meter pattern is similar for all the pipe sizes, disturbance tests with gas meters of two sizes shall suffice.

8.2.3 Durability Test

The pattern and samples of rotary piston gas meters shall be subjected to a durability test. This test shall be carried out as far as possible at the maximum flowrate and with air or gas. The duration of the durability test shall be such that each gas meter measures a volume of air or gas corresponding to 1 000 h of operation of the gas meter at the maximum flowrate. The test shall be completed within two months.

After the durability test, the gas meters, when tested with air of density 1.2 kg/m^3 , using the same standard instruments as those used in the test resulting from 8.2.1 shall comply with the following requirements:

- a) The values of the errors determined at the flowrates specified in 9.2.1 shall not differ by more than 0.5 percent from the errors noted during the test resulting from 8.2.1.
- b) For flowrates between ' $0.4 q_{Max}$ ' and ' q_{Max} ', the difference between the maximum and minimum of the error curve as a function of the flowrate ' q ' shall not exceed 1.5 percent.

8.2.4 Gas Meters with Drive Shafts

In the case of rotary piston gas meters having one or more drive shafts, at least three meters of each size shall be tested with air at a density of 1.2 kg/m^3 for compliance with the requirements of 4.3.2.4 of IS 14439 (Part 1) and 7.4 of this standard.

In case of rotary piston gas meters having several drive shafts, the test shall be carried out on the drive shaft which gives the least favourable result.

Where a pattern embraces gas meters of various sizes, the torque test need be carried out only on the meters of the smallest size, provided that the same torque is specified for the larger gas meters and that the output shafts of the latter have the same or greater output constants.

In the case of gas meters with several values for ' q_{Min} ', only the test described in 8.2.1 for the least value of ' q_{Min} ' need be carried out. The permissible torques for the other working ranges may be calculated from that test result.

Conversion to other ' q_{Min} ' values is governed by the following rules:

- a) Where the flow is constant, the variation in the error is proportional to the torque, and
- b) Where the torque is constant, the variation in

the error for rotary piston gas meters is inversely proportional to the flowrate, and for turbine gas meters it is inversely proportional to the square of the flowrate.

9 INITIAL VERIFICATION AND SUBSEQUENT VERIFICATIONS

9.1 Examination

9.1.1 Gas meters shall be examined and tested to ascertain whether they conform in general to their approved patterns. They shall comply with the requirements of IS 14439 (Part 1) as well as the requirements of this standard.

9.1.2 Gas meters shall be submitted in working order and shall be provided with the required sites for the application of the verification and protective marks.

9.1.3 If gas meters are intended to incorporate ancillary devices operated by the output shafts, these devices shall be attached, unless attachment after verification is expressly authorized.

9.2 Accuracy Tests and Calibration

9.2.1 A gas meter shall be considered to comply with the requirements concerning the maximum permissible errors, if these are met at the following flowrates:

- a) For gas meters with a working range of 1 : 10 to 1 : 30 : q_{Min} , $0.05 q_{Max}$ and $0.1 q_{Max}$ when these values are larger than q_{Min} , $0.25 q_{Max}$, $0.40 q_{Max}$, $0.70 q_{Max}$ and q_{Max} , and
- b) For gas meters with a working range of 1 : 50 : q_{Min} , $0.05 q_{Max}$, $0.15 q_{Max}$, $0.25 q_{Max}$, $0.40 q_{Max}$, $0.70 q_{Max}$ and q_{Max} .

If the tests are done at other flowrates, they shall be at least as effective as those mentioned above.

9.2.2 A gas meter may be verified using a gas other than air, and/or at other than near ambient conditions.

9.3 Additional Markings

The density range in which the errors are required to

comply with the maximum permissible errors may be indicated on the data plate, expressed as:

$$p = \dots \text{ to } \dots \text{ kg/m}^3$$

This marking shall replace the range of metering pressures [5.1(i) of IS 14439 (Part 1)], unless the pressure marking refers to a built-in conversion device.

10 MARKING

10.1 Each gas meter shall bear the markings conforming to IS 14439 (Part 1).

10.2 BIS Certification Marking

The product may also be marked with the Standard Mark.

10.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

11 PACKING

The gas meter shall be wrapped in dust proof paper and placed in the wooden/corrugated box with sufficient packing material all around to prevent any risk of damage or deformation during transit.

- a) Before preparation for packing, each meter shall be dried and cleaned.
- b) Meter openings shall be covered to prevent the entry of dirt and other foreign matter, threaded and machined surfaces shall be well covered with rust preventive coatings.
- c) Flanges and exposed thread connections shall be well protected over their entire surface by providing the suitable protectors.

12 INSTRUCTIONS FOR INSTALLATION AND MAINTENANCE

Installation and maintenance instructions, including for routine checks, shall be provided by the manufacturer.

ANNEX A
(Clause 8.2.2)

DISTURBANCE TEST FOR ROTARY PISTON METERS

A-1 GENERAL

A-1.1 The test specified in this annex shall be carried out with air at clause to ambient conditions at flowrates of $0.25 q_{Max}$, $0.4 q_{Max}$, and q_{Max} .

A-1.2 If the design of the pattern of the gas meter is similar for all pipe sizes, it is sufficient to perform the test on two sizes. Similarity of sizes is assumed if the values of H/D and S/L (see Fig. 1) for any size of meter are equal to or less than those for the tested meters.

A-2 MILD DISTURBANCES

A-2.1 The piping configurations [see Fig. 2(a) and 2(b)] consist of a pipe with a nominal diameter DN_1 and with a length of $5 DN_1$, two elbows with radius DN_1 not in the same plane and a concentric expander with diameter DN_1 and DN and a length between DN and $1.5 DN$.

The values of DN_1 in relation to the values of DN are listed below:

DN (Meter)	DN_1 (Pipe)
mm	mm
50	40
80	50
100	80
150	100
200	150
250	200

DN (Meter)	DN_1 (Pipe)
mm	mm
300	250
400	300
500	400
600	500
750	600
1 000	750

A-2.2 The test shall be carried out with the piping configurations as described in A-2.1 installed $2 DN$ upstream of the meter inlet [see Fig. 2(c)] or with a longer upstream straight pipe and/or flow conditioner, if so specified by the manufacturer.

In the latter case the necessary upstream straight pipe and/or flow conditioner shall be considered part of the approved pattern and specified in the approval certificate.

A-2.3 During the test the shift of the error curve of the meter shall not exceed 0.33 percent.

A-3 SEVERE DISTURBANCES

A-3.1 The same piping configuration as specified in A-2.1 is used with the addition of a half pipe area plate as shown in Fig. 3 installed between the two elbows with the opening toward the outside radius of the first bend.

A-3.2 The provisions of A-2.2 and A-2.3 shall apply accordingly.

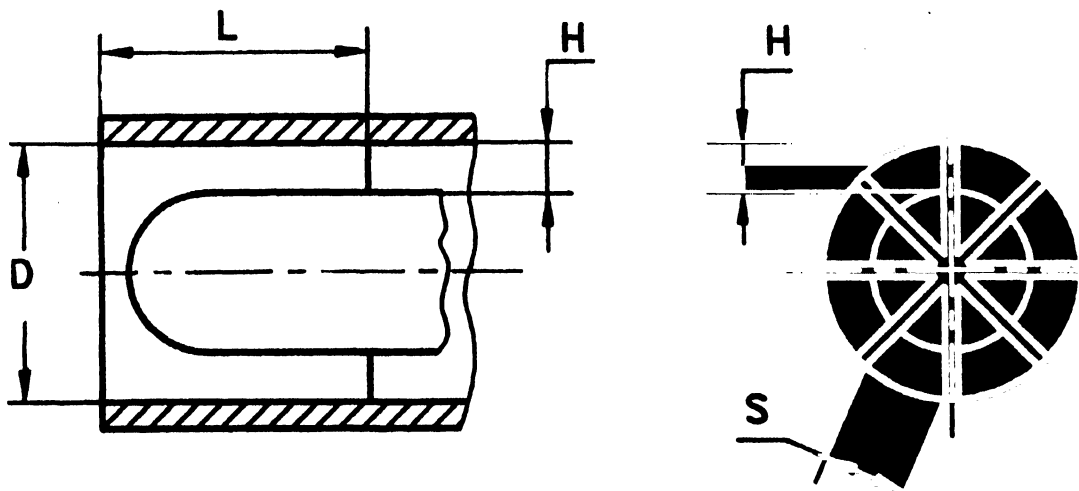


FIG. 1 DESIGN PATTERN OF GAS METER

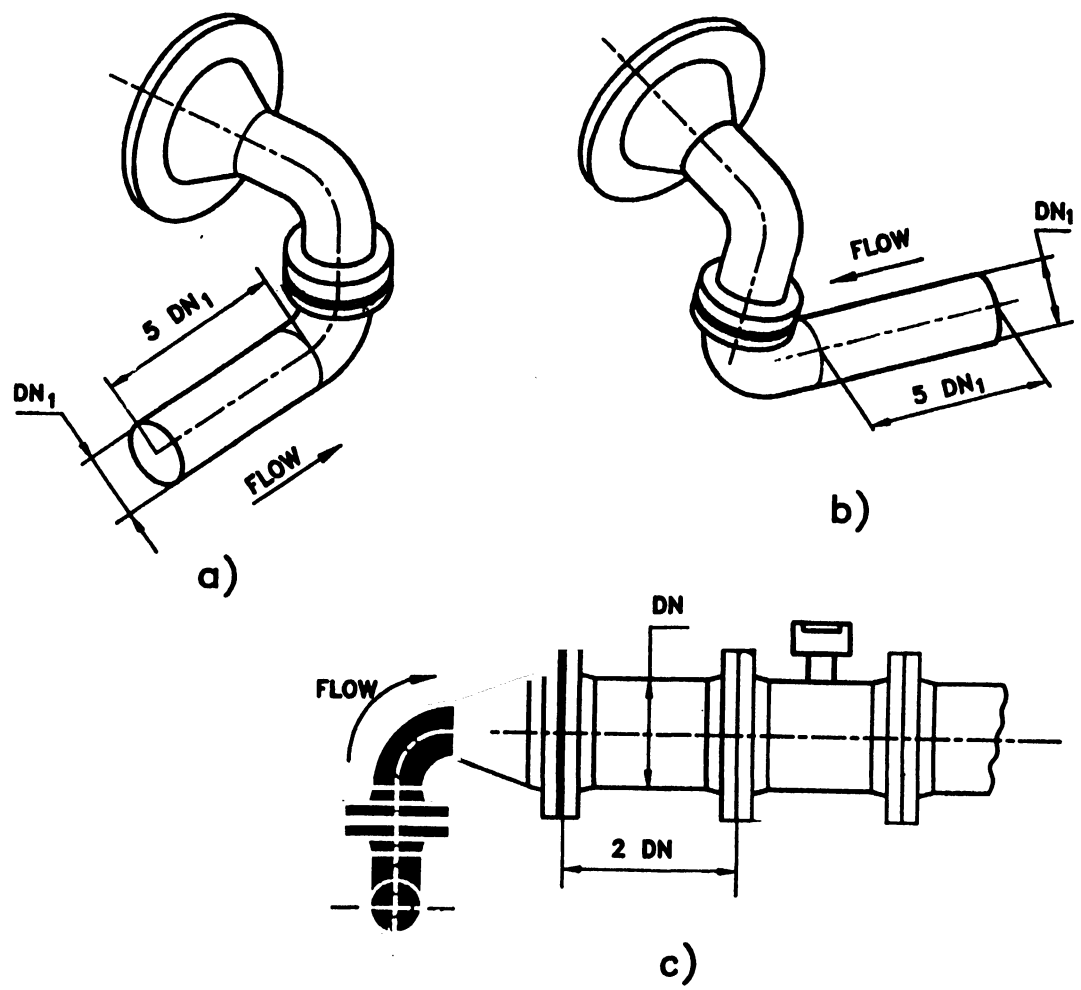


FIG. 2 PIPING CONFIGURATIONS

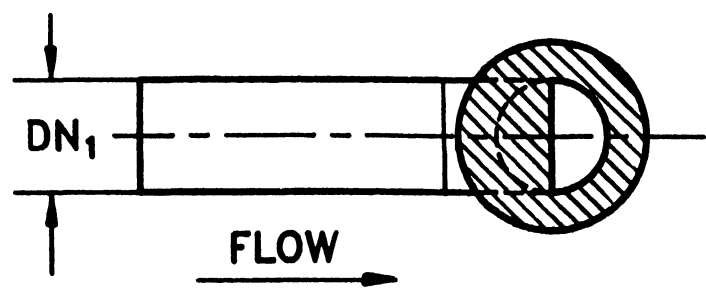


FIG. 3 HALF PIPE PLATE

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Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards : Monthly Additions'.

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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